

Reflection on Lessons Learned: An Analysis of the Adverse Outcomes Observed During the Hurricane Rita Evacuation

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ABSTRACT

In September 2005, nearly 3.7 million people evacuated the Texas coastline in advance of Hurricane Rita's landfall, making the event the largest emergency evacuation in US history. The Rita evacuation underscored the importance of planning for domestic mass-evacuation events, as the evacuation itself led to over 100 of the at least 119 deaths attributed to the storm. In the days preceding Rita's landfall, several cascading, interrelated circumstances precipitated such adverse outcomes. This article explores the series of events leading up to the evacuation's poor outcomes, the response following Rita to amend evacuation plans, and how Texas successfully implemented these changes during later storms to achieve better outcomes. (*Disaster Med Public Health Preparedness*. 2018;12:115-120)

Key Words: evacuation, emergency planning and management, hurricane, natural disaster

In September 2005, less than a month after Hurricane Katrina ravaged the Louisiana and Mississippi coastlines, Hurricane Rita, at one point a Category 5 storm as measured on the Saffir-Simpson Hurricane Wind Scale, barreled through the Gulf of Mexico toward Texas. Having seen the damage caused by Katrina, and compelled by the strength of Rita, many people in the Houston-Galveston region chose not to take a chance. Nearly 3.7 million people evacuated the Texas coastline between Beaumont and Corpus Christi in the 4 days preceding Rita's landfall.¹ What became the largest emergency evacuation in US history quickly devolved into chaos.¹ Stuck on the highways in poorly managed traffic, with peak ambient temperatures reaching 100° F, and not having anticipated such a long drive, many people lacked access to water, food, fuel, and other essential items. In the end, the evacuation itself led to over 100 of the at least 119 deaths attributed to Rita and highlighted the importance of planning for a domestic mass-evacuation event.

In the months before Rita, during the 2005 hurricane season, the Texas Governor's Division of Emergency Management conducted a thorough assessment of its evacuation plans, prepared a series of workshops focused on large-scale evacuations, and hosted its third annual Texas Hurricane Conference.² Speaking at the conference, the then-Texas Governor Rick Perry eerily commented, "It is humbling to think about the many challenges we will face in evacuating densely populated areas if a hurricane heads for certain parts of the Texas coast. It would be an enormous task to evacuate vulnerable populations in a region the size of Houston,"² the country's fourth largest city.

Yet, Texas appeared to be ready for the next big storm, having undertaken a comprehensive review of its evacuation plans and having implemented a number of drills, exercises, and workshops that year for those individuals designated to have leadership roles during an actual evacuation. So, what went wrong when Rita pummeled toward the state's coastline only a few months later?

MASS EVACUATIONS: OVERVIEW AND CONTEXT

Though not a new phenomenon, large-scale evacuations have received growing attention in recent years because of the increasing frequency with which they have been implemented. Large-scale or mass evacuations usually involve at least 1000 people and may be triggered by various events such as natural disasters, technological failures, and terrorist threats.³ Between 1990 and mid-2003, 230 evacuations involving 1000 or more people were executed in the United States, amounting to approximately 1 large-scale evacuation every 3 weeks.³ Of these, 17 involved at least 100,000 people, with hurricanes prompting 15 of those.³ Accordingly, local and state agencies have increasingly invested more into evacuation planning and related issues.³

Evacuations have long been considered an aspect of emergency or disaster management. Although the US federal government has done much in this area over the years, state and local governments remain principally responsible for emergency evacuations.⁴ Under federal law, local emergency-planning officials must "develop emergency plans that encompass evacuation."⁴ The city

mayor, city manager, and county executives have central roles because of their capacity to mobilize necessary responders and assisting agencies. When a disaster involves an entire region, state governors may declare a state of emergency and direct resources to the affected area.⁴ Finally, “[f]ederal assistance is invoked only if state and local resources are overwhelmed in a catastrophic incident or when special equipment is needed;” in these instances, the Federal Emergency Management Agency leads the provision of aid.⁴

Despite having the ability to predict natural disasters, understanding threats posed by other hazards, and acknowledging the need to plan for such catastrophes, the resounding chronic challenge involves our ability to prepare for them.⁵ Some suggest that “in times of crisis, our greatest enemy is rarely the storm, the quake or the surge itself” but rather “[m]ore often, it is ourselves.”⁵ Emergency evacuation planning comprises a wide array of disciplines and issues, such as public education, communication, traffic management, assistance for special-needs evacuees, and coordination between various agencies across multiple jurisdictions at all levels of government. Although most of these topics have been studied extensively in isolation, it is important to understand where and how they intersect.

THE EVACUATION FROM HURRICANE RITA

A Brief History of the Storm: Intensity, Projected Path, and Decision to Evacuate

On September 21, 2005, merely a day after entering the Gulf of Mexico as a Category 2 storm, Rita strengthened and intensified to become a Category 5 hurricane.⁶ Projected to hit Houston and Galveston, Rita stood as the second most powerful hurricane of the season and the fourth most intense storm ever recorded in the Atlantic.⁷ The storm eventually changed course and made landfall early on Saturday, September 24, 2005, as a Category 3 hurricane just east of the Texas-Louisiana border.^{6,7} Although Rita ultimately spared Houston and Galveston a direct hit, the evacuation activities from those and other coastal cities in the days before the storm’s landfall quickly escalated into chaos and highlighted shortcomings in state and local evacuation planning and management.

An unprecedented number of people in Houston and other Texas coastal communities evacuated as Rita approached.¹ Approximately 2.5 million people fled the urban and suburban Houston area.^{7,8} Including evacuees from other Texas coastal communities, the total estimated number of Rita evacuees topped 3.7 million.¹ Surveys conducted after Rita suggest that 53% of evacuees left 2 days before the landfall and that another 19% evacuated 1 day prior.⁹ Fresh memories of the destruction and devastation wreaked by Hurricane Katrina on New Orleans played a significant role in inducing the unexpectedly large outflow.⁷ More than 1800 people died in Katrina,¹⁰ and Houston welcomed as many as 250,000 evacuees in its aftermath.¹¹

Officials at all levels were wary of faltering on their advice to leave, not wanting to witness a repeat of the dreadful situation that unfolded during Katrina due partly to late evacuation orders. On September 21, with Houston facing a Category 5 hurricane, the then-Houston Mayor Bill White implored, “Don’t wait, the time for waiting is over,” and added, “Don’t follow the example of New Orleans and think someone’s going to get you.”⁸ In Matagorda County, the sheriff “warned parents that if they decided to try to ride out the storm and were caught, they could be charged with child endangerment and their children taken into custody.”¹² With such powerful images, pleas, and fears in mind, a record number of people set out to evacuate.

Outcomes of the Evacuation

The evacuation from Rita was unsuccessful because of the high number of deaths attributed to it and the thousands of people who abandoned their evacuation attempt. First, with respect to poor health outcomes among evacuees, ~107 deaths have been linked to the evacuation. In all, an estimated 119 deaths have been attributed to Rita, with 113 occurring in Texas.⁷ Of those 113, only 6 have been “directly” attributed to the storm, meaning they were caused by wind, water, or a storm surge.⁷ The remaining 107 deaths connected “indirectly” to the hurricane were caused principally by activities related to the evacuation and likely resulted from some combination of heat stress, dehydration, and aggravated pre-existing chronic health conditions.^{7,13} At least 10% of evacuation-related deaths have been linked to hyperthermia in motor vehicles, and medical examiners suspected hyperthermia and deteriorating chronic health conditions in another 50% of such deaths.¹³ The other deaths indirectly attributable to Rita include those caused by a fire on a bus carrying nursing-home evacuees (23 deaths) and by evacuating patients from chronic health facilities (10 deaths).^{13,a}

Although no standard mortality rate exists to predict deaths during a large-scale evacuation, outcomes from other mass evacuations highlight the unusual magnitude of the Rita evacuation death toll. The Nuclear Regulatory Commission has emphasized that casualties during evacuations involving 1000 or more persons are generally quite rare, concluding that “[t]he casualties that resulted from [Hurricane Rita] are not typical of evacuations.”¹⁴ For example, in September 1998, Hurricane Georges prompted the evacuation of an estimated 1.2 million people; only 1 death has been directly attributed to the storm in the United States, with no reported deaths from evacuation activities.¹⁵ Similarly, in September 1999,

^aThis paper focuses on the deaths in which hyperthermia was indicated. Further discussion of the nursing-home bus fire and other particular aspects of evacuation planning for special-needs populations is beyond the scope of this paper. For more information generally on these topics, see, for example, *Evacuating Populations with Special Needs: Routes to Effective Evacuation Planning Primer Series*. Federal Highway Administration, US Department of Transportation. April 2009. Renne JL, Sanchez TW, Litman T. National study on carless and special needs evacuation planning: a literature review. Planning and Urban Studies Reports and Presentations. October 2008.

Hurricane Floyd compelled over 2.6 million people to evacuate before its landfall, making it the largest evacuation to date at that time.¹⁶ Again, no indirect, or evacuation-related, deaths were attributed to the hurricane.¹⁶ Further, some two million people fled in advance of Katrina's impending landfall¹⁴; amazingly, only 1 death was attributed to that evacuation.¹⁴

Second, many Rita evacuees eventually gave up after becoming stranded along their evacuation routes. Although the exact number of people who abandoned the Rita evacuation is not known, it is estimated that tens of thousands of people turned home.^{14,17} Rita ultimately spared Houston a direct hit, but the consequences could have been devastating.¹⁷ Moreover, bad experiences have the potential to scar people in a way that leaves them less likely to comply with future evacuation orders.^{3,18} For instance, a former director of the National Hurricane Center hypothesized that a portion of the Galveston area residents ignored mandatory evacuation orders 3 years later during Hurricane Ike because of what they had endured during the Rita evacuation.¹⁸ Although traffic is an unavoidable consequence of evacuating nearly 3 million people from a major metropolitan area, officials can plan for and execute key elements of the evacuation in a way that mitigates risks to evacuees and improves their chances of safely reaching evacuation destinations.¹⁴

Analyzing What Went Wrong

The culmination of events before Rita's landfall underscores that the city and state were not well prepared. Haphazard communication with the public, low projections of the number of potential evacuees, poorly managed traffic, and lack of services available along evacuation routes, all exacerbated by high heat and humidity, led to the death of over 100 evacuees. One of the officials most outspoken about the need for more thorough, well-developed evacuation plans was Bill King, the then-mayor of Kemah (a small town on Galveston Bay).¹⁹ King advocated improved planning and coordination in the event of an area-wide evacuation after finding that the city of Houston and the state of Texas were profoundly underprepared following a close call with Hurricane Lili in 2002. King described:

I began visiting regional and state officials to find out if there were any disaster preparation plans. Basically, I learned, there were none. The Texas Department of Public Safety, charged with emergency management at the state level, gave me the agency's 30-page evacuation plan for the Houston area. I discovered our town's police chief had never seen it, nor could I find anyone else who had ... For the most part, I was blown off. I frequently was accused of being the "Chicken Little" of hurricanes.¹⁹

In the spring of 2005, King predicted many of the shortcomings of state and local evacuation plans that materialized during Rita a few months later. Nevertheless, a report

published by Governor Perry's Office of Emergency Management that March rejected most of King's doubts, finding that "the Houston-Galveston area [was] largely prepared for a major hurricane."²⁰ However, many experts shared King's uncertainty, suggesting that "no one really [knew] whether the Southeast Texas coast could be quickly and safely evacuated in the event of a Category 4 or Category 5 hurricane."²⁰ Their general sentiment could be summarized as "we'll find out when it happens,"²⁰ a frightening prospect for an area vulnerable to powerful storms.

In the days preceding Rita's landfall, several cascading, interrelated circumstances precipitated adverse outcomes. First, inadequate content in officials' communications with the public meant people frequently left home unprepared for the drive to their evacuation destinations. Having to leave on moderately short notice when the stakes appeared high, potential evacuees may not have thought about the basic necessities they would need on the road; or, they may simply have been unaware that it was necessary to pack items such as water, fuel, and extra medications.¹ Experts underscore that a common misconception people have about evacuations concerns the time they will spend on the road. Although "[p]eople tend to think in terms of a four- or five-hour drive to San Antonio or Dallas," trips can easily last longer than 10 to 20 times that, a circumstance officials should publicize.²⁰

Second, not only did the Rita evacuation see an unprecedented number of evacuees, it was an unanticipated number as well. Models used by emergency management coordinators in Harris County forecast 800,000 to 1.2 million evacuees from the area, but over 1 million more than anticipated actually fled.⁸ This ties back to issues with communications, which often came across as unclear and inconsistent. The "fear tactics" imposed in combination with the "Katrina Effect" proved strong motivators for Houstonians to flee, even when it was not necessary. In addition, vague instructions about who should evacuate made matters worse. Houston officials, for instance, encouraged people to evacuate "if they lived in areas that had previously flooded,"¹⁴ and as nobody wanted to take a chance, many decided it best to leave. Estimates suggest nearly two-thirds of people who fled did not need to, causing a large shadow evacuation.¹⁴ Shadow evacuations occur "when people feel they are in danger and begin to leave in advance of, or in spite of, official instructions to avoid doing so."²⁷ Evacuees from Galveston, who were at greatest risk, spent 4-5 hours just trying to make the 50 miles to Houston,²¹ beyond which lay an additional 20- or 30-hour drive to their ultimate destination.

Third, on top of this unforeseen number of often unprepared evacuees jamming the highways, traffic was poorly managed during the evacuation period. Officials wavered on whether or not to employ contraflow, a traffic management technique that uses both outbound and inbound highway lanes for evacuation traffic.⁸ Also, traffic did not begin to move quickly

even after officials had decided to implement it on the highways to San Antonio and Dallas. Despite sounding simple, contraflow is a highly complex operation,²² and state evacuation plans did not cover it, meaning that relevant agencies spent almost 12 hours working together to operationalize the measure.²³ Such action contravenes an early principle of disaster response, which states that new and unfamiliar plans should not be introduced in the midst of the acute phase of a disaster. Texas officials had written-off contraflow as a mechanism to manage evacuation traffic months earlier, which meant that it would be of marginal use, at best, during Rita.

Fourth, the weather in Texas proved brutal and unrelenting during the evacuation. Temperatures reached 100°F in Houston and 95° in Galveston, with humidity remaining around 94%.⁷ In this hot and humid weather, traffic crawled along or came to a standstill for hours and then days.^{7,23} The Harris County Medical Examiner's list of deaths during the evacuation period revealed that some people found unresponsive in their vehicles had recorded temperatures of 107°F, 108°F, and even 112°F.²⁴ In that county alone, there were 9 suspected cases of hyperthermia, with a total of 21 people dying or becoming ill in a vehicle.²⁴ Such outcomes raise questions regarding the extent to which weather (not related to the impending disaster itself) factors into evacuation planning. Texas and, in particular, Houston have notorious reputations for heat and humidity. However, the inclusion of any provisions in evacuation plans that would help evacuees contend with the weather, such as the distribution of ice at shortly spaced intervals along evacuation routes, appear incidental.

Last, a general lack of services en route, including fuel, water, medical care, and restrooms, compounded the other issues. Officials failed to "sufficiently stress the need to carry food, water, pharmaceuticals, and other medical supplies" en route.⁷ Many of these necessities were available in limited quantities along evacuation routes or were difficult to reach when motorists were not permitted to exit the highways because of contraflow operations.^{1,23} All evacuation routes out of Houston pass through rural areas that offered a limited number of gas stations, which quickly exhausted their fuel supplies.²³ Some evacuees attempted to conserve fuel or protect their engines from overheating by turning off the air conditioning in their cars,⁷ elevating the risk for heat-related illness. Ultimately, many vehicles ran out of gas or overheated while idling on the highways, worsening the congestion.^{7,8}

Further, evacuees faced difficulties in accessing medical care en route. Apart from heat and dehydration, other medical needs and emergencies of evacuees included dialysis, oxygen, insulin, and giving birth.⁷ However, heavy traffic "prevented medical workers from quickly responding to the medical emergencies of evacuees."⁷ In addition, evacuation routes requiring evacuees to traverse rural communities created further complications. Rural

areas throughout the United States generally have fewer and less-sophisticated public health and medical care capabilities than do urban areas, a disparity due in part to fewer physicians, hospitals, clinical resources, and public health resources.⁷ Texas is no exception to this urban versus rural variation, with a 2006 study reporting that 65 of the state's counties lack a hospital.⁷ Thus, it was very hard for those who needed it to receive medical care during the evacuation because of traffic and weak infrastructure.

Accordingly, it is difficult to isolate any particular factor as the cause of the "failed" evacuation and unusual morbidity and mortality seen on the roads. Rather, the poor outcomes of the evacuation seemingly resulted from a more inclusive set of cascading and interrelated conditions that prohibited the safe, efficient movement of people away from Houston and Galveston to secure locations. As strong a motivating force as Katrina was in driving the surge of evacuees from Houston, in the end "Rita taught as much about the challenge of leaving as Katrina taught about staying behind."¹² Evacuations involve much more than just the physical movement of people from a place of danger to a more secure location, and the Rita evacuation dreadfully illustrated that.

AFTERMATH OF THE RITA EVACUATION Revision of Evacuation Plans and Management Systems

In October 2005, Governor Perry appointed a Task Force to investigate the challenges observed during the evacuation, and it issued its report in February 2006.¹⁷ To avoid the fuel shortages and problems it precipitated, the group recommended that state agencies collaborate with the private sector in detailing a plan to provide sufficient fuel along major evacuation routes and suggested that a fuel coordinator execute the plan when the time comes.¹⁷ Governor Perry thereafter issued an executive order that made the Texas Department of Transportation and the Texas Oil and Gas Association responsible for coordinating this effort.²⁵ The Task Force report also called for a public education campaign that "encourage[s] citizens to maintain adequate fuel in their vehicles during hurricane season."¹⁷ Governor Perry's executive order has since been translated into a comprehensive emergency fuel support plan, a part of the Texas Emergency Management Plan, complete with a thorough timeline that shows which actors must do what from pre-hurricane season to 120 hours before and after landfall.²⁵

In addition, the Task Force urged that future evacuation plans involve the placement of medical-aid stations and appropriate personnel "at intervals along major evacuation routes."¹⁷ Earlier, in 2005, the Governor's Division of Emergency Management had initiated a new concept called Evacuation Information Centers, which were designed to be roadside facilities along designated evacuation routes and to provide evacuees with fuel, restrooms, and some medical assistance to address immediate

emergency needs.² The Evacuation Information Centers worked well during the initial hours of the Rita evacuation but ultimately did not live up to expectations because of the overwhelming number of evacuees and the traffic that came to a halt when all of those individuals took to the roads.⁷ As of September 2014, the State of Texas Emergency Management Plan calls for the positioning of “comfort stations” along evacuation routes to provide evacuees with drinking water, ice, restroom facilities, and local medical assistance.²⁶ In addition, following the 2005 hurricane season, Texas officials developed a registry for people with disabilities or those otherwise considered “medically fragile” who are likely to need help during a general evacuation.²⁷

More broadly, consideration of household evacuation logistics, including family size and means of transport, reinforce the conclusion that provision of services en route to evacuees in Texas is highly important. Studies indicate that “the overwhelming number of evacuees use their own vehicles” (in Rita, an estimated 91% of evacuees), “tend to rely principally on interstate highways,” and travel relatively long distances (in Rita, an average of 199 miles).⁹ With traffic being an unavoidable consequence of a large-scale evacuation, the provision of services en route becomes critical for safe and effective evacuation. A 2006 survey of residents in hurricane-prone states including Texas revealed that people planned to evacuate to a destination more than 100 miles away.³ In addition, the study revealed why people might elect not to evacuate. Notably, 36% of respondents feared evacuating could be dangerous, whereas another 54% said that roads would be too crowded.³ Though changes to evacuation plans are generally made after a failed evacuation as opposed to being forward-looking,²² emergency planners can use this information to tailor plans to specific localities to help make evacuations flow more smoothly.

Applying Lessons Learned from Rita: Hurricanes Dean and Ike

In the years following Rita, several other hurricanes tested the state’s readiness to deal with another major storm but perhaps without the immobilizing problems seen before. During August 2007, Hurricane Dean churned toward south Texas as a Category 4 storm, raising the possibility that around 100,000 people would need to evacuate the Brownsville area.²⁸ In their preparations, local and state officials demonstrated consistent communications with the public and their ability to pre-stage necessary human and material resources to facilitate a flowing evacuation. Days before its anticipated landfall, Governor Perry called on nearly 25,000 responders²⁹ and sent 60,000-80,000 barrels of fuel to gas stations in the Rio Grand Valley.²⁸ Texas transportation officials and the Shell Oil personnel oversaw the maintenance of fuel inventories and their distribution, “flooding the Texas coastline with gas five days before the storm hit, then moving it along evacuation routes.”³⁰ In addition, Governor Perry insisted at a press conference that “residents ... gather and organize medications and important documents, fill

their vehicle gas tanks and prepare a three-day supply of water and perishable food.”³¹ Ultimately, Dean changed course and did not hit Texas, but preparing for a strike provided an opportunity to practice executing changes made after the Rita disaster.³⁰

Then, in September 2008, Texas faced Hurricane Ike, a major hurricane targeting Galveston and Houston. Local officials issued clear, consistent messages to residents, which resulted in a smaller proportion of shadow evacuees, better coordinated evacuation traffic, and critical resources positioned along evacuation routes. Ike, which eventually made landfall near Galveston, forced the evacuation of 1.2 million people.³² But, evacuation times averaged 6-10 hours, much less than the 18- to 24-hour evacuation trips seen with Rita.³² This success relates largely to the fact that a greater portion of people in non-evacuation zones stayed back, resulting in almost 1 million fewer evacuees.³³ Although 40% of persons living in non-evacuation zones evacuated during Rita, only 21% did so during Ike.³³ Overall, there were ~975,000 fewer evacuees during Ike than during Rita,³³ and it appears that only 1 or 2 deaths were related to evacuation activities out of the 74 total deaths attributable to Ike.³⁴ In addition to fewer people being on the road, local judge Ed Emmett pointed to “the surge of fuel availability on evacuation routes” and “coordinated traffic management that was tied in from [Galveston] to where evacuees were heading” as reasons why the Ike evacuation flowed so smoothly.³²

CONCLUSION

The evacuation from Hurricane Rita highlighted shortcomings in mass-evacuation planning, provided an opportunity to examine key areas for improvement, and demonstrated the importance of developing and implementing efficient, effective plans. With the Rita evacuation regarded largely as a failure, officials have worked to remedy the problems that led to abandoned evacuation attempts as well as unusual morbidity and mortality among evacuees. The relative successes during Hurricanes Dean and Ike demonstrate significant strides. Nevertheless, planning for large-scale evacuations involves thorough analysis of past evacuations, continual development of plans and capacities, and anticipation of future threats.

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Acknowledgments

The author thanks Dr Jennifer Leaning for her guidance and feedback during the writing process and for fostering the author’s growing interest in humanitarian response.

Published online: July 27, 2017.

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